Electricity (Gas) Basic Electricity

Movement of electron

When the application of a force to a material causes the electrons of that material to move from one atom to another, the result is a flow of negative electrical charges; or, stated in different words, an electric current is the flow or movement of electrons from one atom to another.

Diameter

If two wires are the same material and length, the thinner wire will have more resistance than the thicker wire.

Electrons in motion are constantly colliding as voltage pushes them through a conductor.

Ohm's Law Ohm's Law states: The current in a circuit is directly proportional to the applied voltage and inversely proportional to the amount of resistance. This means that if the voltage goes up, the current goes up. If the resistance goes up, the current goes down.

Semiconductor materials include the elements silicon and germanium, and the compounds gallium arsenide, lead sulfide, or indium phosphide. There are many other semiconductors, even certain plastics can be made semiconducting, allowing for plastic light-emitting diodes (LEDs) which are flexible,

Silver, copper, gold, and aluminum all contain one valence electron and are excellent conductors of electricity. Silver is the best natural conductor of electricity, followed by copper, gold, and aluminum

They contain four valence electrons and are characterized by the fact that as they are heated, their resistance decreases. Heat has the opposite effect on conductors, whose resistance increases with an increase of temperature

Amps come from the elctron. Big the conductor more amps you have

Voltage (or volts) is the term used to describe electrical pressure. The source of Electromotive Force (EMF) is used to create a difference in potential (or voltage) between two points in the circuit

Resistance opposes current flow. It is like electrical "friction". This resistance slows the flow of current. Every electrical component or circuit has resistance, including the conductors. Copper is a good conductor. Iron, aluminum, silver, gold and many other metals, are all conductors of electricity

the greatest amount of resistance in an electrical circuit is encountered when electrical energy is converted to heat, light or magnetism and is referred to as an electrical "Load"

In most conductors, resistance increases as the wire temperature increases. Electrons move faster, but not necessarily in the right direction as the atoms are further apart. Most insulators and semiconductors have less resistance as the temperature increases.

Ohm's Law is usually stated or written as:

Intensity of Current = Electromotive Force (EMF) Resistance or Amps = Volts Ohms Or in standard symbol form**: I = E /R** Now, by using simple algebra we can derive two other forms of this same formula**: E = I × R** The current multiplied by the resistance is equal to the voltage difference (or drop) across the resistance**. R = E/ I**

POWER (WATTS)= E(VOLT) multipy (AMPS) I

Why does the electron remain in its orbit and not be pulled into the nucleus?

Centrifugal force

What is the name given to an atom with an unbalanced electrical charge?

Ion

Which unit of measure is used to describe “Electromotive Force”?

Voltage

If the voltage is constant, but the resistance of the circuit is doubled, what would be the effect to current flow?

It would be reduced by one half

Calculate the current through a circuit if it has 50 ohms of resistance and the voltage drop is 24 volts?

Your answer is incorrect.

I=ER$I=E\ /R$
I=24V50Ω$I=24V/50\Omega$
I = 0.48 A

The correct answer is: 0.48 A

Calculate the milli-voltage drop through a circuit if it has 1.5 ohms of resistance and the current flow is 0.25 amps?

Your answer is correct.

E = I x R

E = 0.25 A x 1.5 ohm

E = 0.375 v or 375 mV

The correct answer is: 375

What would be the anticipated resistance of a circuit with an EMF of 120 volts and a current of 6 amps?

Your answer is correct.

R=EI$R=E/I$
R=120V/6A$R=120V//6A$
R = 20 ohms

The correct answer is: 20 ohm

Electricity (Gas) Generating Electricity

If heat is applied to two dissimilar metals or alloys that are joined together, electrons are transferred across the junction, resulting in current flow. This is known as the “Seebeck (or Thermoelectric) Effect” named

Thermocouples are used for two practical applications; to generate electricity for extra low voltage circuits and to act as temperature sensors. Thermocouples used to supply voltage to combustion safety circuits are heated by a pilot burner and can produce 20 to 30 milli-volts. See Figure below. It is important that only 3/8 to 1/2 inch (9 to 13 mm) of the thermocouple tip (hot junction) be inserted into the pilot flame in order to generate the greatest amount of electricity

If thermocouples are designed to act as temperature sensors, the voltage being created by the thermocouple due to heat can then be interpreted using thermocouple reference tables to calculate the temperature at the hot junction

Chemical Reaction (or Electrochemistry)

Pressure (Piezoelectricity)

The piezoelectric effect occurs when the charge balance within a material’s crystal structure is disturbed. When there is no applied stress on the material, the positive and negative charges are evenly distributed so there is no potential difference. When force is applied, the material’s structure changes slightly, the charge imbalance creates a potential difference, often as high as several thousand volts.

vThe important thing is that there is motion within the magnetic field, and that the wire cuts through the magnetic lines of force. Either the conductor in the magnetic field or the magnetic field itself must be in motion. See Figure below. Current flow is the combined result of the magnetic field and motion. This process is called “Electromagnetic Induction”.

Light (or Photoelectricity) “Photo” means light, so Photoelectricity simply means electricity produced by a beam of light. (materials such as silicon that generate an electric current when sunlight shines on them). Photoelectricity is about light (not only visible, but also infrared and ultraviolet) energy being converted into electrical energy and it happens in three different ways known as the photoconductive, photoemissive and photovoltaic effects.

Photoconductive Cell Photoconductive cells are light-sensitive semiconductors in which the resistance decreases with an increase in light intensity (Figure below). Most commercially available photoconductive cells are manufactured from cadmium sulfide (CdS)

Photoemissive Cells Photoemissive cells (or phototubes) is the oldest method of turning light into electricity. They are sealed glass vacuum tubes, inside is a metal plate (usually a cesium alloy) that serves as a negative terminal (or cathode) and a positively charged metal rod (or anode). Incoming photons (light energy) strike the cathode, generating electrons, which are attracted to the anode. Thus current flow is dependent on the frequency and intensity of the incoming photons. The current that flows through the device is typically a few microamperes.

Photovoltaic Cells Like miniature power plants, photovoltaic cells are designed to produce steady supplies of useful, electric power. From small solar cells on electronic calculators to completely photovoltaic roofs, their job is essentially to produce a constant supply of electricity that we can use to power electric appliances or store in batteries for later use. Photovoltaic cells are similar to diodes in that they are made from two layers of semiconductor material placed one on top of another.

The earliest photovoltaic cells converted approximately 1% – 2% of sunlight energy into electrical energy. Today's devices can convert 7% – 17% of light energy into electric energy

Transformers Transformers are electrical devices that use the principles of magnetism to change AC current from one voltage to another. For example, electricity supplied to a single-family dwelling by the electrical utility is 120 volts, but can be changed to 24 volts for the heating control circuit, or into 6,000 volts for spark ignition.

Induction involves two basic principles: 1. A magnetic field (or flux) surrounds a wire when it is conducting electricity. 2. If another wire or conductor is placed in the magnetic field, electricity will be generated in this conductor.

Some transformers have multiple connections (or tappings) on the primary and/or secondary side. These tappings allow the transformer to be used in a number of different applications with a variety of input or primary voltages to achieve the desired secondary voltage, depending on which tappings are used.

Solution: VA (Watts) = Volts × Amps VA = 24

Volts × (0.2A + 0.8A + 0.3A)

VA = 24 Volts × 1.3A

VA = 31.2

Transformer Phasing Phase can be described as the difference in electrical degrees between two waveforms. An AC sine wave will indicate the polarity of the current flow at any specific time. Referring to figure below, the polarity at the top of the sine wave is 120 volts positive and at the bottom 120 volts negative.

Electricity (Gas) Electrical Circuits

An electrical circuit will typically contain all of the following components:

• power source or electromotive force (EMF) • conductor • load • switch

Conductor For current to flow, a complete circuit must be in place between the terminals of the power source, switches and loads. An electrical conductor is a material that accommodates movement of charged particles, or electrons. T

Copper is commonly used for conductor wire as it has a high conductivity. Silver is more conductive, but is not practical in most cases, due to cost. Aluminum is sometimes used as a conductor. However it is only about 60% as conductive as copper, requiring larger gauge wiring

Load The load in a circuit is the power requirement of any device or equipment that converts electrical energy into light, heat or mechanical energy or otherwise consumes electricity to perform work

Switch A switch is a device to make or break (close or open) an electrical circuit. It is a necessary component designed to interrupt the flow of current to the loads on the circuit, or to divert it from one conductor to another

Series circuit

Figure 5 - Voltage Drop in a Series Circuit

1. Total resistance of the circuit is 150 Ω = 10 Ω + 100 Ω + 40 Ω 1
2. Total voltage drop of the circuit is 120 V = 8 V + 80 V + 32 V
3. Total current flow of the circuit is 0.8 A = 120 V 150 Ω

Paraller circuit

1 divide I=E divide R then added them together at and divide by volgate like 24v or 120v
2 then divide by like 120 or 24v ex 120 divide 22 amp

Culcator total resistance without amp
1 RTotal/ 1/ R1 + 1 /R2 + 1/ R3
Getting ressitence without amp

Then divivde by votage with resistance ex 120/2.94 R

Series-Parallel Circuits

Votage drop after parallel circuits and series circuits

E= I multi by R
Ex 4amp multi resistance

How to find amps Irotal R divide ohms

Electronic Resistors A resistor is a two terminal electrical component that provides electrical resistance to reduce the flow of current and regulate the flow of electricity. Resistance is expressed in ohms (Ω) or thousands of ohms called kilo ohms (kΩ). Resistors are used for many purposes such as dividing voltages, generating heat and many others

Electricity (Gas) Electrical Safety

How dangerous an exposure to electric shock can be is dependent on several variables including:

- Current flow – higher current increases the severity of shock.
- Voltage and body resistance – increased voltage means a decrease in the resistance of the body to current flow, thus increasing current flow.
- Pathway through the body and the length of time that the current flows through the body.

One difficulty in establishing exact conditions for electrical safety is that voltage can produce different results depending on the circumstances. For example, with 120 V of common voltage under dry conditions, your body resistance may be 100,000 Ohms. The current flow would be calculated as: I = E R = 120 V 100,000 Ω = 0.0012 A (1.2 mA) A current of 1.2 mA might produce a slight tingle. But if conditions are wet or you are perspiring due to vigorous exercise, your resistance may be as low as 1,000 ohms. Then, the current would be: I = 120 V 1,000 Ω = 0.12 A (120 mA)

Electricity (Gas) Residential Electricity

The electrical code requires that all connections to circuits be made only in outlet or junction boxes. The electrical connections fall into two basic groups: • Solderless terminals and insulators • Soldered connections

Electricity (Gas) Single Phase Motors

Torque Torque is the measure of the force that can cause an object to rotate. The more torque a motor produces the more work it can do. The torque output of a motor is the amount of rotational force that the motor develops and is measured in Newton -meters (Nm). The torque and speed relationship are inversely proportional since the rated output power of a motor is a fixed value. As output speed increases, the available output torque decreases proportionately. The same holds true if the output speed decreases, the available output torque increases proportionately

1 watt is equal to 1 volt multiplied by 1 amp. Watts = Volts x Amps

A joule is the unit of energy in the International System of Units (SI system). It is the amount of heat produced when one amp passes through one ohm of resistance in one second.

Horsepower is a measurement of power. It was developed to determine the amount of work done by a horse. It was later applied to measure work done by a mechanical machine, Work is the force times the distance and power is how quickly you are doing that work. It was determined that one horse could lift 330lbs/100ft/min or (55Olbs/ft/sec) which is equivalent to 750 watts of power or 1.0 horsepower in the international system (SI) and the heat equivalent of 2550BTUs (British thermal units) or 4500 kilograms/meters /minut

E**lectrical Energy & Power Electrical** energy is the result of a flow of electrical charges. This electric energy has the ability to do work. In an electrical motor the energy is transferred to the rotor shaft to produce mechanical motion to do work. During this process energy is lost through friction and heat. When an electrical current is passed through a conductor (even a great conductor) it faces a certain amount of resistance. The loss of energy can be calculated when considering the resistance and the current (electron flow). E**fficiency** Electric motor efficiency is the portion of electrical energy input that is not converted to mechanical power but is converted to heat. Efficiency is defined as the output of the motor (power available at the shaft) divided by the supply input to the motor (power available at the source).

An electric motor is a machine capable of converting electrical energy into mechanical energy. The induction motor is the most widely used electric motor because it combines all the advantages offered by the electrical energy such as low cost, ease of supply and distribution, clean handling, and simplicity. Two main types of electric motors are:

- Alternating current motors
- Direct current motors

Most electric motors consist of the same basic construction. They contain 2 main parts a stator (typically made up of wire windings and a ferrous metal where electrical current is applied) and a rotor (usually in the middle of the stator and is free to rotate).

Alternating Current Motors Single-phase alternating current is used for different types of single or three phase motors. In single phase motors the alternating power supply simply oscillates the magnetic fields (the poles just switch back and forth).

Direct Current Motors Direct current motors operate in a similar way to alternating current motors. They contain a stator that is stationary and an armature (similar to a rotor) that contains windings capable of generating a magnetic field when current is applied. One additional component is needed for some direct current motors called a commutator.

Types of Single-Phase Motors A single-phase motor runs on a single alternating current electrical power source. The main windings on the stator are wound in the opposite direction, so they would produce different magnetic fields

They include split phase motor, capacitor start/induction run, permanent slip capacitor and capacitor start capacitor run

Two Pole & Four Pole Motors Two pole and four pole motors are different based on the number of magnetic poles that are present on the rotor. A 2 pole motor will have north(+) and south(-) magnetic field present in the rotor whereas a 4 pole motor will have two north(+) and 2 south(-) magnetic fields present on the rotor. A two-pole motor consumes less energy, has high revolution per minute, are quiet and have good efficiency. This type of motor has lower horsepower and torque. They are designed for light workloads. A four pole motors consumes more energy and has fewer revolutions per minute. It will deliver higher torque per horsepower with double the work output. It is noisy and less efficient that the two-pole motor.

Varying Speeds Single phase AC motor speed can only be changed two ways, one by changing the input voltage or two by adjusting the input frequency. The most efficient way of changing the speed of a motor is by using a variable frequency drive (VFD) or electronically commutated motor (ECM).

Electronically Commutated Motors (ECM) An ECM controller converts alternating current single phase power to direct current power and then pulses that current at a desired frequency. This allows control over the motors speed in a similar way to a VFD. ECMs are a very efficient way to vary the speed of a motor and they offer some advantages over VFD controlled motors ; they are low heat devices, create low startup/shutoff velocities,

The split phase motor typically uses a single phase 120 volt power supply and has a rating of 1 HP or less. Split phase motors are used in applications where starting torque requirements are low. Both windings are energized when the motor is started. When the motor reaches about 75% of its rated full load speed, the start winding is disconnected from the circuit by a centrifugal switch. Split-phase motors are also known as resistance phase motors. ngs various switches can be used. One type of switch is called a centrifugal switch. Typically, the switch will open when the motor reaches 75% of the rated full load speed. Another type of switch that can be used is called a momentary switch.

A Capacitor start motor is much like the split-phase induction motor in that it has two windings, a start winding (auxiliary winding) and a main windingUnlike a split-phase motor, both the starting and main windings have similar resistance; therefore, to create the rotating magnetic field a capacitor is used. A capacitor is used to place the starting winding out of phase with the main winding. The added bonus of a capacitor is an increase in the motor’s starting torque due to the starting winding having a similar resistance to the main winding. The capacitor stays in the circuit long enough to bring the motor up to 75% of the rated full load speed. Then, similar to a split phase motor a centrifugal switch removes the starting winding and the capacitor from the circuit, so they don't burn out.

A Permanent-split capacitor motor is much like the capacitor start motor in that it has two windings, a start winding (auxiliary winding) with a capacitor in series and the main winding. The purpose of the start winding with the capacitor is to create a rotating magnetic field. The difference is that the capacitor and the start winding remain in the circuit when the motor gets up to the rated speed. The advantage being higher efficiency and higher power output. Another difference worth noting is no starting mechanism (centrifugal switch) is needed and the rotation is reversible.

Special applications include fans and blowers, air conditioners, coolers, furnaces, unit heaters, roof ventilators, dehumidifiers, garage door openers, and other applications that require more torque. The permanent-split capac

The shaded pole motor, like all induction motors, has a stator and a rotor. The stator carries a main winding and a shaded winding know as the shaded coil. The shaded coil is usually a solid copper ring wrapped around a portion of the stator's metal case. A shaded pole motor may have more than one shaded pole. Due to the difference in resistance between the copper shaded ring and the stator's metal construction (usually some form of iron) the induced current (present in both metals) creates a difference in polarity within the stator's magnetic field. The shade pole can not be removed from the circuit due to magnetic field being generated from induced current. Shaded pole motors are self starting, low torque, low efficiency, and designed with low power ratings. Shaded pole motors are cheap to make and reliable due to their very basic construction.

Thermal Protection An electric motor can overheat and burn out for various reasons. A worn bearing can cause increased friction, a stuck motor shaft can stall the motor, or even a motor starting failure can result in an overheat. For these reasons thermal protection is necessary to prolong or save an electric motor from failure. Overcurrent Protection The most common type of **overcurrent protection** is the use of fuses and circuit breakers. If there is too much current passing through the wiring of the motor or a short is created through the motor housing a fuse can be utilized to stop the flow of electricity by breaking the circuit. Overcurrent protection is extremely useful to protect a service technician from electric shock as well as the components of the motor itself. There are many different types of fuses and circuit breakers that are used and applicable for electric motors.

Causes of Motor Failure Many factors can contribute to why a single phase electric motor will fail. Load, environment, application, and construction can all contribute to motor failure. Given the wide range of applications it is sometimes difficult to pinpoint the exact

reasonpairs can be made or a replacement motor is needed. The majority of issues can arise from faulty centrifugal switches, thermal protection, and capacitors.

Electricity (Gas) Three Phase Motors

For the same size, the single-phase induction motors develop about 50% of the output as that of three-phase induction motors.

The starting torque is also low for asynchronous motors/single-phase induction motors

The efficiency of single-phase induction motors is less compared to that of threephase induction motors.

Three-Phase Power The three-phase power curve consists of three separate single-phase curves evenly separated by 120 electrical degrees. The benefit of the three-phase supply is that there is always a phase at maximum (peak) power. Whereas in a single-phase system, sometimes there is no power output. Three-Phase Power The three-phase power curve consists of three separate single-phase curves evenly separated by 120 electrical degrees. The benefit of the three-phase

supply is that there is always a phase at maximum (peak) power. Whereas in a single-phase system, sometimes there is no power output.

The rotor of a three-phase motor is called a squirrel cage due to its appearance. It is cylindrical in shape and made of laminated high grade silicon steel. This is done to reduce losses due to heat (eddy current and hysteresis). The conductors on the rotor are made of solid copper rods and are short circuited by copper end rings on both ends. This gives the appearance of a cage

It is easier to adjust the speed of a DC motor than an AC motor, but AC is more available and easier to transform. Therefore, AC voltage and frequency must be changed to DC. AC power is sent into a full wave bridge rectifier (converter) that will put out non filtered DC voltage.

What determines the atomic number of an element?

The correct answer is: Number of protons in the nucleus

Why does the electron remain in its orbit and not be pulled into the nucleus?

The correct answer is: Centrifugal force

What must occur for an atom to become negatively charged?

Select one:
a.
More electrons than protons.

What is the name given to an atom with an unbalanced electrical charge?

The correct answer is: Ion

How many valence electrons would be found in an atom that is categorized as a semiconductor?

The correct answer is: 4

alculate the current through a circuit if it has 50 ohms of resistance and the voltage drop is 24 volts?

Your answer is incorrect.

I=ER$I=ER$
I=24V50Ω$I=24V50Ω$
I = 0.48 A

The correct answer is: 0.48 A

Calculate the milli-voltage drop through a circuit if it has 1.5 ohms of resistance and the current flow is 0.25 amps

Your answer is correct.

E = I x R

E = 0.25 A x 1.5 ohm

E = 0.375 v or 375 mV

The correct answer is: 375

What would be the anticipated resistance of a circuit with an EMF of 120 volts and a current of 6 amps? our answer is correct.

R=EI$R=EI$
R=120V6A$R=120V6A$
R = 20 ohms

The correct answer is: 20 ohm

What is the name of the effect that refers to heat being applied to two dissimilar metals or alloys that are joined together that results in current flow?

The correct answer is: Thermoelectric effect

What action occurs when a battery produces electricity?

The correct answer is: Electrochemistry

If the current is increased through a conductor, what effect would this have on the strength of the magnetic field surrounding the conductor? The correct answer is: It will increase

What method of producing voltage was discovered by Faraday that linked electricity and magnetism? The correct answer is: Electromagnetic induction

dentify advantages that alternating current has over direct current. Select all that apply. The correct answers are: AC voltage can be changed with a transformer, Generators naturally make AC power, AC converts easily to DC

What are the two standard methods of connecting the single-phase winding of generators to form three-phase circuits? The correct answer is: Wye and Delta

Which part of the light spectrum are CdS photo conductive cells most sensitive? The correct answer is: Visible light

What is done to produce a semi conductor with an unbalanced electrical charge for use in a Photovoltaic cell? The correct answer is: Doped or chemically modified

When referring to the transfer of electricity due to friction; what is the ranking system called that list the order in which materials gain or lose electrons?

The correct answer is: Triboelectric series

hat is considered the positive terminal in a dry (voltaic) cell? The correct answer is: Carbon rod

What type of electricity is produced when pressure is applied to certain crystalline materials such as quartz? The correct answer is: Piezoelectricity

What is the typical cycle frequency for AC electrical power in North America?

The correct answer is: 60 Hertz

How many degrees apart are the coils in a three phase generator?

The correct answer is: 120

What is another name for a CdS photoconductive cell?

Light dependent resistor

Your answer is correct.

RTotal= 6Ω + 2Ω + 4Ω RTotal=12 Ω
I=E/R I= (120V / 12Ω) I=10A
E=I×R 60 V=10 A×6 Ω
20 V=10 A×2 Ω
40 V=10 A×4 Ω

What will be constant in a parallel circuit? The correct answer is: Voltage drop across each load

Your answer is partially correct.

You have correctly selected 2.
1 / RTotal = (3 / 12Ω) RTotal= (12Ω / 3) RTotal = 4Ω
I= (E / R) 4A = (24V / 6Ω) 2A = (24V / 12Ω)
6A = 4A + 2A
E=I×R 24V = 4A × 6Ω 24V = 2A × 12Ω

The correct answer is: Referring to the illustration below; calculate the total circuit resistance, circuit ampacity and the voltage drop through each load.
What is the definition for “Power”?

The correct answer is: The rate at which energy is expended,

What is the unit measure for “P” when using the formula: The correct answer is: Watts hat is the term used to describe a device that uses energy of a power source to perform work?

Select one:

The correct answer is: Load

Circuits and Controls Switches

lectrical Circuits are opened or closed by the use of a _________?

The correct answer is: Switch

A switch that has one pole and one contact is known as ________

The correct answer is: SPST

If a pole can be thrown in one of two positions it is known as a _______?

The correct answer is: SPDT

Temperature Switches

Metals expand when heated and contract when cooled. The principle of thermal expansion is used for several control devices that regulate temperature change. The temperature disc responds to temperature changes by moving from a concave to a convex shape to break a set of electrical contacts, such as in the case of a flame roll-out switch or a high limit, t

he bimetallic strip operates on the fact that not all metals expand at the same rate. These devices use the warping action created when two dissimilar metals having different coefficients of expansion are joined together at one end and are exposed to a temperature change.

The heating anticipator is a variable (or adjustable) resistor that produces heat in a thermostat to prevent extreme temperature changes within a space. The heat created by the anticipator increases the thermostat rate of response.

Figure 6 Heat Anticipator When the furnace is running, the current that controls the furnace travels from the mercury switch, through a wire to the heat anticipator. It travels through the wire until it gets to the adjustment arm, and from there it travels through the hub of the anticipator ring and down to the sub base of the thermostat. The farther the adjustment arm is positioned (moving clockwise), the more of the resistor the current has to pass through. Like any resistor, this one generates heat when current passes through it.

The cooling anticipator adds heat to the cooling thermostat’s bimetal element the same way as a heating anticipator. Unlike the heating anticipator, cooling anticipators are not adjustable; they are sized by the manufacturer of the thermostat. The cooling anticipator is placed in parallel with the cooling thermostat, whereas the heating anticipator is in series with the heating thermost

PID Controllers (Programmable Thermostats) PID stands for proportional integral derivative, which describes the process of following variables and determining whether correction measures are necessary to rectify errors. An example of that would be the controller is set to 70°F, the thermostat then confirms the process if the temperature is at 70°F. If the controller receives a signal indicating the temperature is lower than the set temperature then the controller sends a signal to start the heating or cooling appliance.

Common sensor technologies in use today include: • Bimetallic mechanical or electrical sensors. • Expanding wax pellets • Electronic thermistors and semiconductor devices • Electrical thermocouples These may then control the heating or cooling apparatus using: • Direct mechanical control • Electrical signals • Pneumatic signals

The two switches are connected together with a brass jumper, which connects the same power source to both switches. The jumper can be removed if the high limit is to be wired into the 24 Volt control circuit. Located on the front dial of the combination high-limit/fan control are a temperature scale and three adjustable tabs. The first tab is the fan-off setpoint, this is the temperature that the fan switch will open and de-energize the fan motor, this tab is usually set at a temperature about 20º F (11º C) above the typical thermostat setpoint. The second tab is the fan-on setpoint, this is the temperature at which the fan switch closes its contacts and energizes the fan motor, it is typically set 20º to 30º F (11º to 17º C) above the fan-off setpoint. T

The bimetal strip will first close the fan switch and start the fan motor. If an overheating condition occurs due to insufficient airflow (faulty fan motor or fan switch, too low a fan speed or plugged air filter), the bimetal strip will continue to warp until the high-limit cutout temperature is reached and then opens the limit switch

Aquastat Like solids, liquids expand when heated and contract when cooled. When a liquid is sealed in a narrow tube (called a capillary tube) the force created by the liquid expanding within the capillary tube can be used to operate an electrical switch or control, such as a High Limit Aquastat.

Aquastats are common controls used with hot water boilers. The operating aquastat actuates in response to a rise in water temperature. For example, if the operating aquastat is set at 180º F (82º C), the contacts will remain closed until the water reaches this temperature. At this point, the contacts open and cut off the power to the gas valve.

The high limit aquastat actuates in response to an excessive rise in water temperature. It is a normally closed switch that opens the control circuit if the water temperature reaches its setpoint, usually 200º F (93º C). Refer to the CSA B149.1 code book for maximum high limit settings. Some high limit aquastats are equipped with a manual reset device. For example, if the water temperature reaches 200º F (93º C) and the contacts open, the switch must be manually reset to close the contacts.

If the high limit has been tripped, the system should be checked as to the cause of the overheating prior to resetting the high limit. The high limit aquastat should be located in the upper portion of the boiler where the highest water temperature is expected. The operating (or low limit) aquastat and the high limit aquastat may be mounted side by side. In some cases, they are consolidated into one component, even sharing a single sensing element

There are three basic mounting methods for aquastats: • Remote Bulb • Surface mounted or strap-on • Direct mounted using an immersion (or thermo) well

Capillary tubes can also be used with thermostats and oven controls, they often have a temperature limit of 650º F (343º C) and usually contain a fluid similar to a light oil

Direct mounted aquastats use an immersion well that is threaded into the water space of a boiler, or into the run of a tee. The sensing bulb is then inserted into the immersion well. Usually a thermally conductive paste is applied to the inside of the immersion well prior to inserting the sensing bulb of the aquastat.

What type of switch uses a concave or convex disk of metal to open or close contacts due to changes in temperature?

he correct answer is: Flame roll-out Switch

A type of switch that is constructed to close a set of contacts on a temperature rise, is an example of a _________?

The correct answer is: Fan Switch

The rate of response in a thermostat can be improved by the addition of what component

The correct answer is: A Heat Anticipator

he numbers on a heat anticipator are an indication of current draw in ________?

The correct answer is: Amps

The "R" Terminal in a thermostat is for what purpose?

The correct answer is: 24 Volt supply

The process of following a set of variables and determining whether corrections need to be made is used in what type of equipment?

The correct answer is: A Programmable Thermostat

Residential heat pump thermostats have a terminals to energize _______ when is cooling mode.

The correct answer is: The Reversing Valve

In a heat pump thermostat the second stage heating contact controls______?

The correct answer is: The operation of supplemental heat

What type of thermostat uses a type of gas between two metallic disks?

The correct answer is: Bellows Thermostat

In a combination Fan/ High limit control the fan switch is located on which side of the unit, if looking at the face.

The correct answer is: Left side

In the combination Fan/ High limit control why would a gas fitter need to remove the brass jumper?

The correct answer is: To supply the high limit with 24 volt power

Aquastats are used in what type of appliance?

The correct answer is: Hot Water Boilers

What are the methods for mounting aquastats? (select all that apply)

The correct answers are: Remote Bulb, Surface Mounted, Direct mounted in an immersion well

A pressure switch incorporates a diaphragm which is exposed to the fluid it is sensing and activates a switch in response to the changes in water, steam, and air or gas pressure. They are used on hot water boilers, steam boilers, gas supply piping, as well as air supply fans, blowers and exhaust fans used for gas burner systems\

Pressuretrols Operating steam pressure switches on steam boilers are called pressuretrols. Operating pressuretrols are adjustable as is the differentia

Figure 2 - Siphon Loop (Pigtail) A high-limit pressuretrol is a normally closed switch that opens its contacts if the pressure setting is reached. Like all safety-limits, it is wired in series with the operating control and gas valve to prevent the gas valve from becoming energized if an unsafe condition occurs.

Gas Pressure Switches Gas pressure switches are required by the CSA B149.3 code on burner systems that operate with gas pressures that exceed 0.5 Psig (3.5 kPa). They automatically shut off the gas supply to the burner in the event of an overpressure or an under pressure condition in the burner valve train.

Air-Proving Switch A pressure (or air-proving) switch is used as a safety device when the combustion air is supplied mechanically or the venting of an appliance is controlled mechanically. Generally, the single pole switch typically used allows electrical current to flow when the pressure or vacuum is at an acceptable operational level based on the manufacturer’s design

he type of pressure switch or switches used depends on if they are to be used in a conventional appliance or a high efficiency condensing appliance. If used with a single stage conventional appliance the pressure switch will have one hose leading to the body of the draft inducer fan. Single stage condensing appliances will have will have two hoses on the pressure switch, one for sensing the pressure at the draft inducer/burner enclosure and the other for sensing proper venting pressure at the condensate collector box. Two stage appliances may have two pressure switches and modulating appliances may have three pressure switches.

Pressuretrols are used in what type of system?

The correct answer is: Steam Boiler systems

Another name for the piping (siphon loop) installed from the boiler to the pressuretrol and pressure gauge is called________?

Select one:
The correct answer is: A pigtail

When burners systems operate with gas pressures that exceed 0.5 Psig what is required to be installed according to the CSA B149.3?

The correct answer is: Gas pressure switches

According the CSA B 149.3, if the pressure drops below 50% of the appliance regulator set point, the low pressure normally open switch is required to_____?

Open

In general, an air proving switch is of what basic design?

he correct answer is: A single pole

When the air supply is controlled mechanically, before ignition the blower must do what?

The correct answer is: Pre purge the combustion chamber

Float Activated Switches The low-water cutoff switch actuates in response to fluid movement. If the water level in the boiler (steam or hot water) falls below the minimum safe level, the low-water cutoff switch opens its contacts and cuts off power to the main gas valve. There are two basic types of low-water cutoff switches. Float type low-water cutoffs and probe type low-water cutoffs The float type is a normally open switch that is held closed by the float on top of the boiler water. If the boiler water level falls below the setpoint, the float mechanism lowers and breaks the electrical contact.

The probe type low-water cutoff is a normally open switch that uses the boiler water to conduct current between the terminals on the end of the probe or between the probe and the boiler shell or piping. If the water level falls below the level of the probe, the circuit between the terminals is broken.

What are two types of L.W.C.O. switches?

Select one:
a.
Float type and Probe type

In conjunction with steam boilers how many automatic low water cut offs must be installed?

2

If a low water cutoff is attached to the boiler by pipe and fittings what must not be places upstream of the L.W.C.O? The correct answer is: Shutoff valves of any type

To facilitate cleaning of the lines with L.W.C.O.'s what shall be placed at every right angle turn? The correct answer is: A cross fitting

In a hot water heating boiler, the installed L.W.C.O. must be equipped with what device?

The correct answer is: A manual reset switch

At what height are L.W.C.O.'s designed to be installed, according to manufacturer's literatureThe correct answer is: Above the lowest safe water level

When attaching L.W.C.O.'s to a hot water boiler with pipe what is the minimum size of pipe that can be used? The correct answer is: 1″ NPS

Motor Activated Switches Some electrical devices use a small motor to open a damper or valve to allow the flow of a fluid, such as vent gases or water. Many of these devices incorporate end switches to prove that the damper or valve is in the open position before burners or pumps are energized. Vent Dampers Electrically operated vent dampers use a damper motor to drive open the normally closed damper prior to the burners being ignited. In order to prove that the damper is fully open, a cam is used to mechanically activate a switch (called an end switch)

Relays Relays are common devices used to remotely operate other circuits. A relay is an automatically operated switch or switches that are controlled by another circuit (either air or electric). If the relay is operated by compressed air, otherwise known as instrument air, it is called a pneumatic relay.

The relay is composed of two basic components; the coil, which is a "load" that performs work by physically moving a switch and a "switch" which controls the power supply to another load

There are several types of relays with a variety of voltage designations and amperage ratings. Although the variations are many, the basic operating principles are the same. The switch portion of the relay is identified the same way as a manual switch; by the number of poles and throws. The relay in the image above would be classified as a "Single Pole Double Throw" (SPDT) relay whereas the wiring diagram of the relay below would be classified as a "Double Pole Single Throw" (DPST). In the image below a 24 Volt circuit is being used to control the operation of a 120 Volt pump circuit. A Single Pole Single Throw switch controls the power supply to the 24 Volt relay coil. 120 Volts is being supplied to the "Common" terminal of the relay switch and the power supply to the pump is taken from the "Normally Open" contact. Without the relay coil energized, the pump will not operate. e 13 - Time Delay Relay Contactors look and react similar to a relay. Relays are generally used for switching light loads like control circuitry and relatively small motors. Contactors are used for bringing larger loads online like compressors and large motors. Contactors can have 1, 2, 3 or 4 sets of contacts (or switches) and are usually NO contacts. Contactor coils are available in several voltages, for example; 24 VAC, 120 VAC, 208 VAC, 230 VAC, or dual rated at 208/240. A typical use for a contactor is using a 24 VAC control circuit to switch a high voltage/high amperage load like a compressor. Some larger contactors have changeable coils.

ow many contacts are on a SPDT switch? Two Switches can be operated by hand or they can be activated in response to changes in : The correct answers are: Temperature, Pressure, Fluid Movement, Magnetism

elect four switches that are activated in response to changes in temperature : The correct answers are: Thermostat Switch, Fan Switch, High Limit Switch, Flame Roll-out

What is the purpose of a heat anticipator? The correct answer is: Avoid overshooting room temperature

What do the numbers on a heat anticipator indicate? The correct answer is: Amperage

When is a heat anticipator energized? The correct answer is: When the thermostat closes its contacts

What is the purpose of an operating aquastat?

The correct answer is: To maintain the boiler water temperature.

What is the typical setting for a high limit aquastat? The correct answer is: 200 °F (93 °C)

hat is usually applied to the inside of the immersion well prior to inserting the sensing bulb ? The correct answer is: Conductive Paste

What term is used to describe a pressure switch that controls the operation of a steam boiler? The correct answer is: pressuretrol

Where would you find the low water cut-off located on a steam boiler?

Select one: he correct answer is: On the side of the boiler at the minimum water level

Why do vent dampers also include an end switch? The correct answer is: To prove the damper is fully open prior to igniting the burners

What is the most common voltage required for zone valve m

The correct answer is: 24 volt

What is the purpose of a transformer? he correct answer is: Increase or Decrease AC voltage

What term is used to describe the process of generating electricity in the secondary winding's of a transformer? The correct answer is: Induction

What would be the VA rating of a 120/24 volt transformer that is able to deliver 1.667 Amps? VA (W) = V × A

VA = 24 V × 1.667 A

VA = 40

The correct answer is: 40.008

How many 24 volt zone valves could be operated from a 120/24 volt transformer with a 40 VA rating if each zone valve required 0.32 Amps? A=VAV$A=VAV$
A=40VA24V$A=40VA24V$
A=1.667A=1.667
1.667A ÷ 0.32A = 5.21

Therefore you could operate **5** 24volt zone valves.

The correct answer is: 5
The furnace fan control contacts open when the circulating air : The correct answer is: cools down

Which of the following would be classified as a normally “open” switch? The correct answer is: Automatic fan switch

What is the typical fan-off setpoint for a combination high-limit/fan control? The correct answer is: 20 °F (9°C) above the thermostat setpoint

What is the typical setting for a high limit aquastat ? The correct answer is: 200 F

Appliance

Which of the following gas-fired appliances could be used to heat domestic hot water ?

The correct answers are: Storage type water heater, On demand/wall hung water heater, Indirectly heated with a boiler in conjunction with a storage tank

What is meant by the term underfired when referring to storage-type hot water tanks?

The burner is located under the storage tank
What is meant by the term recovery rate when discussing storage-type hot water tanks?

he correct answer is: The maximum amount of hot water that a tank can produce per hour at a given temperature rise.

What are the three basic principles behind a Flammable Vapor Ignition Resistant (FVIR) system ?

The correct answers are: A one way intake system to control the intake of air, A flame arrestor plate, A sealed burner compartment doo

Which of the following best describes a Thermal Cut-Off (TCO).

The correct answer is: A TCO de-energizes the gas valve if excessive temperatures are experienced in the combustion chamber.

Which two types of ignition systems are typically used with power vented hot water tanks?

The correct answers are: Intermittent Pilot , Direct Ignition

What other terms are sometimes used to describe a tankless domestic hot water heater ?

The correct answers are: On-Demand, Wall Hung Water Heater, Instantaneous

What are the three styles of tankless water heaters available based on venting and air supply?

Select one or more:
a.
Outdoor

b.
Indoor, direct vent

c.
Indoor, non direct vent

Put the following firing sequence in order for a tankless water heater.

1. [The circuit board monitors the inlet and outlet water temperatures]
2. [The ventor fan is energized and does a pre-purge]
3. [The pressure switch proves]
4. [The igniter is energized]
5. [The modulating control opens to low fire]
6. [The flame rod proves ignition]
7. [The igniter is de-energized]

Which formula is used to determine the flow rate through a tankless water heater?

\Your answer is correct.

The correct answer is: FlowRate=BtuhChangeinTempx500$FlowRate=BtuhChangeinTempx500$

What is meant by the term “Cold Water Sandwich” when referring to tankless water heaters?

Your answer is correct.

The correct answer is: The fixture receives hot water, cold water and then hot water

How many US gallons per minute could be provided by a tankless water heater with an input of 199,000 Btuh and is 81% efficient; if the cold water supply temperature is 50°F and the outlet temperature is set to 110°F?

199,000 Btuh x 81% = 161,190 Btuh

Flow rate = 161,190Btuh60F×500161,190$Btuh60F$×500
Flow rate = 5.37 GPM

The correct answer is: 5.37

List the three major differences between a conventional (low efficiency) furnace and a standard (mid-efficient) furnace?

ou have correctly selected 2.
The correct answers are: Heat Exchanger, Burner Ignition, Draft Control

List three operations of a control module on a standard (mid-efficient) furnace?

The correct answers are: Initiate the ignition sequence, control the run cycle, perform the shutdown sequence

What is required in many jurisdictions when draining the condensate from a high efficiency furnace to a building’s drainage system?

Select one:
a.
Neutralizer

Where are the vent sizing tables located for BH venting?

c.
The manufacturer’s literature

What type of boiler can be used for other than a private residence or an apartment with less than five units that meets the requirements of ASME Boiler and Pressure Vessel Code in British Columbia?

The correct answers are: A power boiler with a heating surface of 2 m^2 (21.5 $ft.^2$) or less, A heating boiler with a heating surface of 3 m^2 (32.3 $ft.^2$). or less

What are the three basic ratings associated with heating boilers?

The correct answers are: Net Output, Input, Gross Output

Which of the following is a description of the Gross Output of a boiler?

The correct answer is: The total heat output of the boiler

Which of the following is a description of a Firetube Boiler ?

The correct answer is: Boiler contains the flue gases within the boiler tubes and the water is outside the tubes.

Which of the following is the description of the term “Pass” when referring to firetube boilers?

The correct answer is: When the flue gas travels the length of the boiler.

Which of the following is the definition of a Wet Base Boiler ?

Select one:
a.
Boiler has water below the combustion chamber.

Which two boiler types would be considered High Mass ?

Select one or more:
a.
Firetube
b.
Cast Iron Sectional

What are the three main types of flame detectors found on boilers?

The correct answers are: Flame Rods, Infrared Detectors, UV Detectors

What are the three basic designs of gas fireplaces?

The correct answers are: Insert, Zero-Clearance, Free Standing

What are the three venting options for gas fireplaces?

The correct answers are: Natural Draft, Power Venting, Direct Vent

What is the typical control circuit voltage for a gas fireplace that utilizes a standing pilot?

The correct answer is: 140 mv

What is the main concern when installing a Gas Log Set ?

The correct answer is: Poor venting creating potential indoor air quality issues

What is the purpose of the operating control on a hot water boiler?

The correct answer is: To energize the burner when the boiler water gets too cold

If the dip tube in a hot water tank breaks at the top of the tank, the most likely result would be :

The correct answer is: the incoming cold water could be drawn from the hot supply, leaving hot water at the bottom of the tank

Which part of the CSA B149.1 code specifies requirements for the installation of specific types of appliances ?

Select one:
a. 5
b. 6
c. 7
d. 4

Except where permitted by Clause 4.13.2 of the CSA B149.1 code, what is the minimum clearance from the side of a boiler to combustible material ?

The correct answer is: 18 inch (450 mm)

Which testing standard is used to determine a fireplace's efficiency ?

The correct answer is: CSA P.4.1 – 02

Which type of gas fireplace is designed to be installed into an existing wood-burning chimney?

The correct answer is: Insert

What is the maximum allowable working pressure for "Low Pressure" steam boiler?

The correct answer is: 15 Psig

What is the heating value for 1 EDR in a hot water heating system ?

he correct answer is: 150 Btu / Feet sq.

Which device in a steam system is designed to only allow condensate to enter the return main ?

The correct answer is: Steam Trap

What is the primary form of heat transfer from an infloor hot water heating system ?

The correct answer is: Radiant

Which section of the ASME Boiler and Pressure Vessel Code describes the construction requirements for heating boilers?

Select one:

d. IV

Where does condensing of the flue gas begin in a high efficiency furnace?

The correct answer is: Secondary heat exchanger

Approximately how many Btu’s are gained when condensing a pound of water from the flue gas in a high efficiency furnace?

The correct answer is: 970

What is used to monitor inlet and outlet w

The correct answer is: Thermistors

Which device is used in a conventional natural draft hot water tank to control draft velocity ?

The correct answer is: Draft Hood

What device is used to direct the cold inlet water to the bottom of a hot water tank?

Select one:

The correct answer is: Dip Tube

When installing a domestic-type clothes dryer, what is the minimum distance that the moisture exhaust duct can terminate from a buildings’ fresh air intake?

The correct answer is: 3 Ft (900 mm)

What must be done to the return-air ducting of a furnace if it is installed in an enclosure that contains a spillage-susceptible appliance?

The correct answer is: It must be sealed

Which of the following locations is not permitted to receive make-up air from a Direct-Fired Make-Up air Heater ?

Select one:

a.

Dormitory

Except where permitted by 4.13.2 , what is the minimum clearance from a combustible wall to the back of a free-standing gas fireplace ?

The correct answer is: 6 inch (150 mm)

Which of the following gas fireplaces can be installed in a bedroom ?

The correct answer is: Direct-Vent, Zero-Clearance

What is the minimum distance that a pool heater may be installed from a property line?

The correct answer is: 18 inch (450 mm)

What is the maximum distance above the floor that the discharge line from a pressure relief valve serving a domestic water heater may terminate?

The correct answer is: 12 inch (300 mm)

If a unit heater is installed in a garage, what is the minimum permitted distance from the base of the heater and the garage floor?

The correct answer is: 8 feet (2.4 m)

Except where permitted by Clause 4.13.2, what is the minimum distance from the top of a unit heater to a combustible ceiling?

The correct answer is: 1.5 feet (0.45 m)

What is the minimum clearance from combustible material above a residential gas range if no protection is added?

The correct answer is: 30 inch (750 mm)

If an appliance requires a clearance from combustibles above it of 12 in., what minimum clearance would be acceptable if the combustible material was covered with 28 gauge sheet metal on 1/4 in. insulating millboard?

he correct answer is: 9 inch

If a gas appliance is located in the attic of a single family dwelling, what are the minimum dimensions required for the access opening to the attic?

The correct answer is: 24 inch x 30 inch (600 mm x 750 mm)

The Combustion Safety Circuit The combustion safety circuit detects the presence or absence of a flame. If a flame is not proven, the combustion safety circuit prevents or terminates the flow of gas to the main burner and/or pilot burner. Combustion safety circuits incorporating standing pilots can be designed to mechanically interrupt the flow of gas with a safety shut-off valve, or to electrically interrupt the control circuit using a switch.

Combustion Safety for Standing Pilots The two components necessary for a combustion safety circuit utilizing a standing pilot are: a thermocouple (or thermopile) and a safety shut-off valve (or safety switch). The thermocouple is the power supply for the combustion safety circuit. When heated by the pilot burner, the thermocouple will generate a small electrical charge: approximately 20 to 30 millivolts. This is enough power to energize an electromagnet in the power unit, the electromagnet will create enough of a magnetic field to hold a valve open or a switch closed.

When the hot junction is heated, a small voltage is generated at the cold junction. The greater the temperature difference between the hot junction and the cold junction the greater the voltage generated. For this reason, it is important that only 3/8 to 1/2 inch (10 mm to 13 mm) of the hot junction is heatedOne of the ends of the cold junction is connected to the copper outer sleeve of the thermocouple, while the other end of the cold junction is connected to an insulated wire inside the copper sleeve

Having a smaller tip area, not only do they heat up quickly, they cool quickly increasing the flame failure response time. Another device that looks similar to a thermocouple and creates electricity from the heat of a standing pilot is a thermopile (pilot generator or powerpile). A thermopile is composed of several thermocouples attached together in series. It is easy to distinguish a thermopile from a thermocouple because it is bigger. When subjected to heat, a much greater voltage is created, up to 750 millivolts. Thermopiles create enough voltage to not only power the combustion safety circuit but also the control circuit. Thermopiles are available as either a two wire or coaxial design.

- Coaxial Thermopile The thermocouple or thermopile supplies enough voltage to energize a safety shut-off valve or safety switch as long as the pilot is lit. If the pilot flame should go out, the valve mechanically shuts off the gas supply. In 100% safe systems, the valve shuts off the gas to both the main burner and the pilot burner. For non-100% (or 80%) safe systems the valve shuts off the gas to the main burner only

1 - Combination Gas Valve As stated previously, the combustion safety circuit can also be electrically controlled with the use of a safety switch instead of a safety shut-off valve. 100% safety switches break the control circuit by the use of a switch to prevent the gas valve from being energized as well as they include a pilot valve to shut-off the gas supply to the pilot burner

Flame Rod Flame rods are the most common flame sensing device for appliances with inputs under 1,000 MBH (300 kW). Flame rods are small diameter metal rods supported by an insulator. The tip-end of the rod projects into the flame. They are typically made of “Kanthol”; a high temperature alloy capable of operating in temperatures of up to 2,400 ºF (1,300 ºC) or “Globar” which has a maximum operating temperature of 2,600 ºF (1,425 ºC).

Flame Rectification An AC supply voltage is applied across the electrodes. In the first half of the AC cycle, the flame rod is positive and the ground rod is negative. The positively charged ions will flow to the negatively charged grounding area. The large grounding area increases the capacity to hold electrons. Positively charged ions pull a high stream of electrons into the flame. This results in higher current flow from the grounding area to the flame rod during the first half of the cycle.

Optical flame detectors are divided into three groups according to the part of the flame spectrum that they are scanning: • Ultraviolet light; gas-filled UV detection tubes • Visible light; photo cells • Infrared light; lead sulphide (Pbs) cells UV Detectors Flame scanners operating in the UV wavelength use an ultraviolet detection tube. In this type of system the flame is considered present when UV radiation is detected. UV detection tubes are made with quartz; the tube is then sealed and filled with gas. A quartz lens is needed to focus the UV radiation through the optical shutter window directly on the two detector tube electrodes

UV flame detectors respond to UV sources in a flame. However, it is possible for the detector to respond to other sources of UV radiation such as: • Hot refractory (above 2,500°F [1,370°C]) • Spark ignition • Welding arcs • Halogen light

Approximately how many volts will a thermocouple generateThe correct answer is: 20 – 30 millivolts

A thermocouple is made of two dissimilar metals joined together at one end, what is the term used for that connection? The correct answer is: Hot junction

According to the CSA B149.3 code, thermocouples are limited to combustion safety circuits that have standing pilots, and to what input BTU rating?

The correct answer is: 400 000 Btu

Thermocouples used in low volume appliances in conjunction with a gas that has a specific gravity greater than 1.0, shall have a maximum flame failure response time of? The correct answer is: 20 seconds

Another type of device that operates similarly to a thermocouple is known as? The correct answer is: Pilot Generator

n 100% safe systems, the valve shuts off the gas to both the main burner and the pilot burner. For non-100% (or 80%) safe systems the valve shuts off the gas to what device only. he correct answer is: Main Burner

An appliance with a flame sensor has an input greater than 120 KW what is the maximum FFRT (Flame Failure Response TimThe correct answer is: 4 seconds

What is the most common flame sensing device for appliances under 1,000,000 Btu? The correct answer is: Flame Rod

Flame rods are typically made from what material? The correct answer is: Kanthol and Globar alloys

What is the current that is generally conducted through a

? The correct answer is: 2 – 4 µA

Optical flame detectors are divided into three groups, the detection type that scans the visible light spectrum is known as?

The correct answer is: Photo Cells

UV flame detectors respond to UV sources in a flame. However, it is possible for the detector to respond to other sources of UV radiation such as? (select all that apply) The correct answers are: Hot Refractory, Spark Ignition, Welding Arcs, Halogen Lights

The • Operating Controls • Safety (or Limit) Controls • Actuators**Control Circuit** On a call for heat, the control circuit energizes the gas valve, causing it to open, and allows gas to flow to the main burner. When the call for heat is satisfied, the control circuit de-energizes the gas valve, shutting off the gas.

• Operating Controls • Safety (or Limit) Controls • Actuators

Operating controls have an adjustable setpoint and contain a sensing element and a switch. The sensing element responds to changes in the medium being sensed

Safety or limit controls shut off the gas valve if continued operation would cause an unsafe condition

Actuators control the supply of gas to the main burner based on an electrical signal from the operating control

Control Modules Control modules provide ignition and flame failure protection for automatically ignited burners. In conjunction with safety limits, operating controls and interlock devices, these controls automatically sequence with the burner/blower motor, ignition, and fuel valves. The control module cycles automatically when the operating control closes its contacts.

Direct Spark Ignition This version does not have a pilot. The spark igniter directly lights the main burner on a call for heat and a flame sensor detects the flame. If a flame is not detected on the trial for ignition, the gas valve closes. After a specified amount of time, usually seconds, the ignition module will try ignition again. Again

Intermittent Pilot Ignition This version has a pilot which is only ignited when there is a call for heat. The pilot is located near the main burner, and on a call for heat, the ignition control module or circuit board energizes the pilot valve inside the main gas valve causing it to open, it then initiates a spark at the head of the pilot assembly to light the pilot. A flame sensor is located at the pilot assembly and as soon as the flame is detected; the circuit board or ignition control module opens the main valve inside the gas valve. The pilot then lights the main burner(s). If a flame is not sensed, the trial for ignition could repeat itself for up to four trials, and then the control module will lock-out for a specified period of time (typically one hour depending on the gas appliance o

Hot Surface Ignition Hot surface ignition can be either directly fired or indirectly fired to a pilot (a Honeywell Smart Valve is an example of indirectly fired to a pilot). The hot surface igniter is made from a silicon carbide element which glows red hot when electricity is passed through it. Most hot surface igniters require 120 volts but there are a few systems that require 24 volts (a Honeywell Smart Valve Hot Surface Pilot Igniter uses 24 volts). It is important not to touch the element because oil from the fingers can cause problems with the hot surface igniter element. The most common reason for failure of a hot surface igniter is that they develop a crack

Electronic Ignition using a Mercury Bulb This system uses a mercury switch to prove there is a flame on a pilot light. Mercury bulb systems usually use spark ignition to light a pilot and the mercury switch proves the pilot flame. Once the switch proves the pilot flame the main valve in the gas valve opens and the pilot lights the main burner(s). Due to environmental concerns involving mercury, not many manufacturers use this type of electronic ignition.

Control circuits can be broken down into three categories, devices in that circuit are known as operating control, safety controls, and _________?

The correct answer is: Actuators

Operating controls have adjustable set points and some type of sensing element used to sense? (select all that apply) The correct answers are: Temperature, Pressure

Safety switches are designed to shut off what device if there is an unsafe condition present? The correct answer is: The Gas Valve

In a gas dryer which device would be considered and safety limit? The correct answer is: Door Switch

For an intermittent pilot system, if the control module sensed an overheating condition and the high limit opened its contacts, what would be de-energized?

Select one:

The correct answer is: The Transformer

On most appliances that use a DSI, the ignition module will go into lock-out mode after _____ attempts to detect a flame 3answer3

A HSI has an element that is made from what material? The correct answer is: Silicon Carbide

Fan Circuits The circulating fan blows warm air from the furnace, through the ducting, to the rooms that require heat. The cooler air from the rooms, return to the furnace through the cold air return duct. The fan's operation can be controlled by either a temperature-actuated switch or a timer-actuated switch. The main function of the fan switch is to energize the circulating fan when the heat exchanger has reached the fan-on setpoint temperature and to deenergize the fan when the heat exchanger has cooled to the fan-off setpoint. T

Figure 2 - Combination Fan/Limit Control with Manual Setpoints Timer-actuated fan switches may or may not have an adjustable fan-on time, but the fan-off time is usually adjustable. The switch or switches are typically located on the circuit board of the appliance. ypes of Furnaces The blower or circulating fan is arranged differently depending on the furnace type. The three major classifications of furnaces are: • High Boy • Low Boy • Horizontal High Boy Furnaces High boy furnaces can be divided into two main types; up-flow and down-flow or counter-flow.

To determine the temperature rise, operate the furnace with the burners firing for approximately 10 to 15 minutes. Ensure all registers are open and all duct dampers are in their final (fully or partially open) position. Drill or punch a hole in the return and supply ducts large enough to insert a thermometer. The hole in the return duct should be within 6 ft. (2 m) of the furnace. The hole in the supply plenum should be 2 – 3 ft. (600 – 900 mm) from the furnace where it is not influenced by the radiant heat from the heat exchanger.

Multi-Speed Fan Motor Multi speed fans can be wired with as many as five available speeds to match the requirements of the building and the temperature rise of the furnace.

For example: A cooling capacity of 30,000 Btuh/hr would equal 2.5 tons. 30,000 Btuh/hr ÷ 12,000 = 2.5 Tons Cooling systems are usually designed to work with airflows between 350 and 450 CFM per ton, with 400 CFM per ton being the most common. Based on the previous example, the airflow requirements for a 2.5 ton cooling system would be: 2.5 tons × 400 CFM⁄ton = 1,000 CFM

CFM = Btuh (Output) 1.08 × Temperature Rise

In a forced air furnace the fan’s operation can be controlled by what? (select all that applThe correct answers are: Temperature-actuated switches, Timer actuated switches

The difference in temperature between the fan-on and fan-off setting is calledThe correct answer is: The fan control differential

When replacing temperature-activated switches it is recommended that the switches be reinstalled in what location? The correct answer is: Near the heat exchanger

Using a timer actuated heat on and heat off fan switch, delays can be adjusted, it is recommended that these switches be set initially to what timing? The correct answer is: Factory Setting

The difference in temperature between the air entering the blower chamber from the cold air return plenum and the hot air leaving the supply plenum is the definition of ____________?The correct answer is: Temperature Rise

To determine temperature rise in a furnace it is recommended that a hole be drilled in the supply and return plenums to accommodate a thermometer.

Select one:
a.
True

Temperature rise is controlled by the fan speed, to reduce the temperature rise the fan speed must be _____?The correct answer is: Increased

ESP is the abbreviation for? The correct answer is: External Static Pressure

urnace Maintenance and Safety Checks

Where is the high limit control usually located on a furnace? he correct answer is: On the front partition, detecting air flow past the heat exchanger

How do you test a furnaces’ high limit? The correct answer is: Disconnect power to the fan and call for heat.

Where is the auxiliary high limit usually located on a counter-flow furnace ? The correct answer is: In the fan compartment

What could cause a flame roll-out switch to trip ? The correct answer is: A lack of combustion air.

If the brass jumper is in place in a combination high-limit/fan control, how much voltage would you expect to see being supplied to the high limit? The correct answer is: 120 Volts

What adjustments can be made on a combination high-limit/fan control? The correct answer is: Fan-off set point, Fan-on setpoint, High-limit set point

If you increased the "Heat Off Delay" time on an integrated furnace control module, would it make the system more comfortable or economical? The correct answer is: More economical

Where should the furnace's thermostat be located ? The correct answer is: 1400-1500 mm. off the floor

What are the two most common types of direct drive fan motors? The correct answers are: PSC, ECM

If a furnace has a rated output of 90 MBH, a temperature rise of 50°F, how many cubic feet per minute of air must the fan deliver? CFM = Btuh/(1.08 x temperature rise)

CFM = 90,000/(1.08 x 50F)

CFM = 1.666.67

The correct answer is: 1666.67

What is the purpose of a pressure switch on a furnace? The correct answer is: To prove the inducer fan is working

How could you determine if an inducer fan is creating sufficient pressure (or vacuum) to operate the pressure switch? correct answer is: Insert a barb tee into the sensing hose and use an incline (or digital) manometer

What would be the possible result if an appliance had a plugged flue passage or heat exchanger, if it was over firing, or if there is a lack of air supply?

The correct answer is: Flame Roll Out

Which types of appliances may be vented with Type-B gas venting? The correct answer is: Natural Draft and Fan-Assisted Category 1

What is the purpose of a pilot turn down test ? The correct answer is: To ensure that the pilot burner is in the correct location to safely ignite the main burner with minimum pilot flameWhat is the anticipated voltage of a thermocouple during an open circuit test?

Select one:

The correct answer is: 20 - 30 DC millivolts

When should a combustion analysis be performed on a furnace? The correct answer is: Before and after all adjustments.

How do you perform a spillage test on an appliance equipped with a draft hood? The correct answer is: Use a match

What are the four different ways used to express an appliance’s efficiency? he correct answers are: AFUE, Combustion Efficiency, Steady State Efficiency, Thermal Efficiency

A furnace is clocked through a low-pressure natural gas meter. It takes 80 seconds for the 2 cubic foot test dial to make a complete revolution. If the temperature rise through the furnace is 50°F when the circulating fan is delivering 1,365 CFM, what is the thermal efficiency of the furnace?

Input = 3600sec/hr80sec/rev$3600 sec/hr 80 sec/rev$ x 2cu.ft/rev x 1000Btu/cu.ft = 90 000 Btuh
Btuh (Output) = 1.08 x 1 365 CFM x 50F = 73 710

Thermal Efficiency = Btuh (Output) / Btuh (Input) x 100 = 73 710Btuh/90 000Btuh x 100 = 81.9%

First remove the plug in the outlet pressure tapping of the gas valve, insert a barb fitting, connect the manometer and start the appliance."

The above statement would be the first step when checking which of the following?

The correct answer is: Manifold Pressure

If the supply and manifold pressure are correct but the clocked input is incorrect, identify the most likely problemThe correct answer is: Incorrect orifice size

How do you determine the air supply and vent sizes for a direct vent appliance? The correct answer is: The manufacturer’s literatureWhere must the air supply duct terminate when supplying a low volume installation? The correct answer is: Within 1 foot above and 2 feet horizontally of the burner.

What is the recommended procedure if a home is found to contain 30 PPM CO prior to servicing the furnace? The correct answer is: Advice occupants to check for symptoms, check all vented and unvented appliances, including the furnace, check for other potential sources including attached garages

Which of the following is not one of the steps involved for inspecting a furnace's heat exchanger ? The correct answer is: Adjust the manifold pressure.

Which of the following would not be necessary when servicing a furnace ? The correct answer is: Adjust the dip switches. Why is it recommended to use a checklist when servicing a furnace?

Select one:

The correct answer is: Helps prevent missing any steps. On a previous correctly operating furnace, short cycling starts on a high limit set at 200 °F (93°C). The most likely cause would be: Your answer is incorrect.

The correct answer is: dirty air filters

o decrease the input of a gas burner, you would : The correct answer is: reduce the manifold pressureThe correct answer is: reduce the manifold pressure

A short in which of the following components would cause the burner to run continuously? The correct answer is: Thermostat wiring

A flame that is waving or rolling out when the air circulation fan on a furnace comes on may indicate: The correct answer is: a cracked heat exchanger

A customer complains that the furnace air circulating fan cycles ON and OFF frequently but the burner remains ON until the thermostat is satisfied. The fault is more than likely: The correct answer is: too high of a fan speed

During the heating cycle of a forced air furnace the burner cycles ON and OFF but the fan runs continuously. This could be caused by: During the heating cycle of a forced air furnace the burner cycles ON and OFF but the fan runs continuously. This could be caused by: correct answer is: all the options are correct

What is the maximum flame failure response time for a thermocouple 90sec

What is the typical flame current range through a flame rod circuit ? he correct answer is: 2-5 micro ampsHow much resistance would you expect through a silicon nitride igniter? The correct answer is: 11-17 ohms

How many Btu's are gained in a high efficiency furnace by condensing a pound of water vapour? 970 vapou ans

If an appliance has a rated input of 120,000 Btuh and a rated output of 96,000 Btuh, what is its combustion efficiency?

Select one:

Your answer is incorrect.

96000 Btuh / 120000 Bhuh x 100

The correct answer is: 80 %

How much more air must be supplied to an appliance with a draft control device as compared to a fan assist appliance of the same input? The correct answer is: 100 %

Which Table in the gas code would be used to size the air supply duct for a low volume appliance without a draft control device installed within an airtight structure? The correct answer is: 8.2Which code rule lists requirements that must be followed if a heat exchanger is found to be defective? The correct answer is: 4.21

Which unit of measure is used to verify that a motor's capacitor is satisfactory? The correct answer is: Microfarads

If a cooling coil has a rated capacity of 36,000 Btuh, how many cubic feet per minute of airflow should the circulating fan deliver through the furnace?

Select one:

Your answer is incorrect.

36000 Btuh / 12000 Btuh = 3 tons

3 tons x 400 cfm ton = 1200 CFM

The correct answer is: 1200

If a 120/24 volt transformer is wired "out of phase", what would be the anticipated voltage between the L1 terminal on the primary side and the C terminal on the secondary side of the transformer? The correct answer is: 144 volts

Which of the following scenarios could cause the pressure switch to open its contacts? The correct answer is: Scale build up in the inducer fan

Boiler Maintenance and Safety Checks

What are the two types of low water cut-off devices encountered on a boiler ? The correct answer is: Float and Probe

What are the two types of low water cut-off devices encountered on a boiler ?

Feedback

Your answer is incorrect.

The correct answer is: Float and Probe

Question text

Is the low water cut-off always mounted directly to the boiler?

Select one:
a.
No

b.
Yes

Feedback

Your answer is incorrect.

No, in some installations the low water cut-off is mounted in a parallel pipe arrangement next to the supply riser (hot water) or boiler (steam).

The correct answer is: No

Question text

How often should low water cut-off devices be disassembled, cleaned and checked?

Feedback

Your answer is correct.

The correct answer is: Once a year

Question text

What is the most common cause of feeder or low water cut-off problems involving steam boilers?

Feedback

Your answer is correct.

The correct answer is: Failure to observe blowdown procedures

Question text

What is a common installation mistake involving probe-type low water cut-offs installed external to a hot water boiler?

Feedback

Your answer is incorrect.

The probe is too long for the installed location and therefore lacks proper clearance

The correct answer is: The probe is too long

Question **6**
Incorrect
Mark 0.00 out of 1.00
Flag question

Question text

How many and what type of valves would be encountered on the blow-down line serving a steam boiler?

Feedback

Your answer is incorrect.

2 valves; 1 quick opening gate valve or angle body globe valve and 1 slow opening y-pattern globe valve (minimum 3/4 inch pipe size)

The correct answer is: 2 valves; 1 quick opening gate valve or angle body globe valve and 1 slow opening y-pattern globe valve (minimum 3/4 inch pipe size)

Question text

What is the purpose of a water gauge glass on a steam boiler ?

Feedback

Your answer is correct.

It enables the operator to observe the actual water level

The correct answer is: It enables the operator to observe the actual water level.

Question text

Is it possible to safely test the high-limit aquastat on a boiler?

Select one:
a.
No

b.
Yes

Feedback

Your answer is correct.

Jumper the operating control to allow the water temperature or steam pressure to reach the high limit setpoint. If the hot water boiler manufacturer will allow, turn the high limit aquastat down below the operating aquastat setpoint. Verify that the high limit temperature matches the actual water temperature

The correct answer is: Yes

Question **9**
Incorrect
Mark 0.00 out of 1.00
Flag question

Question text

Where should the flow switch be located on a low mass hot water boiler?

Feedback

Your answer is incorrect.

The flow switch is located in the hot water supply piping leaving the boiler

The correct answer is: The flow switch is located in the hot water supply piping leaving the boiler

How would you test the opening point for a relief valve installed on a hot water boiler?

Select one:

Feedback

Your answer is incorrect.

Close the isolation valves and then slowly increase the water pressure at the PRV until the relief valve setpoint is reached.

The correct answer is: Close the isolation valves and then slowly increase the water pressure at the PRV until the relief valve set point is reached.

Question text

At what pressure should the pressure reducing valve be set when installed on the make-up water line serving a hot water heating boiler?

Feedback

Your answer is correct.

3 to 4 Psi above the static head pressure

The correct answer is: 3 to 4 Psi above the static head pressure

What would be the minimum cut-in temperature for an operating aquastat installed on a non-condensing boiler if the heating system is designed for a 20°F temperature drop?

160F

Feedback

Your answer is incorrect.

160^0 F (71^0 C) = 140^0 F (60^0 C) + 20^0 F (11^0 C)

The correct answer is: 160F

Mark 0.00 out of 1.00
Flag question

Question text

What would be the minimum cut-out temperature for an operating aquastat installed on a non-condensing boiler if it had a 15°F differential designed for a 20°F temperature drop?

Feedback

Your answer is incorrect.

The correct answer is: 175F

Question text

What methods could be used to restore the proper air to water ratio in a steel expansion tank ?

Feedback

Your answer is correct.

Close the isolation valve to the expansion tank and then open the drain on either the Airtrol fitting or the sight glass as applicable.

The correct answer is: Close the isolation valve to the expansion tank and then open the drain on either the Airtrol fitting or the sight glass as applicable.

Question **15**

How do you determine the required air pressure for a diaphragm expansion tank?

Feedback

Your answer is correct.

The correct answer is: Static (or fill) pressure + 4 Psi

Question text

Where is the best location for a diaphragm expansion tank ?

Feedback

Your answer is correct.

The correct answer is: On the supply piping before the circulator

Question text

What is the difference between a feed water valve and a pressure reducing valve ?

d.
A PVR has a wider turn down ratio

Feedback

Your answer is incorrect.

A feedwater valve not only reduces pressure it also has a manual fast fill handle

The correct answer is: A feedwater valve not only reduces pressure it also has a manual fast fill handle

Question text

Where is the air scoop or separator located in a hot water heating system?

Feedback

Your answer is correct.

On the supply piping leaving the boiler upstream of the circulator (at the point with the highest temperature and lowest pressure)

The correct answer is: On the supply piping leaving the boiler upstream of the circulator

Question text

In a multi-zone heating system, which device would typically control the operation of a zone valve?

Feedback

Your answer is correct.

The correct answer is: The zone thermostat

Question text

Should a wet rotor pump be installed with the motor shaft horizontal or vertical?

Select one:
a.
Verticle

b.
Horizontal

Feedback

Your answer is correct.

Horizontal, to ensure that water is circulated inside the rotor can, cooling the motor and lubricating the bearings

The correct answer is: Horizontal

Question text

Feedback

Your answer is incorrect.

The supply water temperature must be at least equal to the highest temperature system or heat transfer unit being supplied

The correct answer is: The supply water temperature must be at least equal to the highest temperature system or heat transfer unit being supplied

Flag question

Question text

How would you determine if an inducer fan is creating sufficient pressure (or vacuum) to operate the pressure switch?

Feedback

Your answer is incorrect.

Connect either an incline manometer or digital manometer to the sensing hose from the inducer fan and apply a call for heat.

The correct answer is: Connect either an incline manometer or digital manometer to the sensing hose from the inducer fan and apply a call for heat.

Question text

What would most likely be the cause of a burner flame having solid yellow tips ?

Feedback

Your answer is incorrect.

The correct answer is: A lack of air usually primary air

Which of the following would best describe a low pressure steam system?

Feedback

Your answer is incorrect.

The correct answer is: 15 PSIG or less

Question text

What is the difference between a flue damper and a vent damper?

Feedback

Your answer is incorrect.

Location
A flue damper is upstream of the draft control and a vent damper is downstream of the draft control

The correct answer is: Location

Question text

Which of the following conditions could cause the burner(s) to shut down?

Feedback

Your answer is incorrect.

The correct answer is: Air collecting around a poorly installed probe-type low water cut-off

Question text

Which types of valves are typically used on the blow-down line of a steam boiler?

Feedback

Your answer is correct.

The correct answer is: Gate valve and a Y-pattern globe valve

Question text

Which of the following devices would be typically used to protect a low-mass residential hot

Feedback

Your answer is correct.

The correct answer is: Flow switch

Question text

How often should the relief valve setpoint be tested on a hot water boiler?

Feedback

Your answer is incorrect.

The correct answer is: Annually

Question text

What should be the setpoint for the pressure reducing valve located on the make-up water line serving a residential hot water boiler, if the maximum height of the heating system is 30 feet?

Feedback

Your answer is incorrect.

The correct answer is: 17 Psi

Question text

Feedback

Your answer is incorrect.

The correct answer is: 60 °C

Question **32**

Question text

What is the difference between the cut-in and cut-out temperature for an operating aquastat with a fixed differential?

Feedback

Your answer is incorrect.

The correct answer is: 2 - 5 °F

Question text

Which of the following could cause the relief valve on a hot water boiler to discharge only after the burners have ignited?

Feedback

Your answer is incorrect.

The correct answer is: A water-logged expansion tank

Question text

What is the optimal ratio of water and air in a steel expansion tank?

Feedback

Your answer is incorrect.

The correct answer is: 1/3 air, 2/3 water

Question text

When is the best time to charge a diaphragm expansion tank?

Feedback

Your answer is incorrect.

The correct answer is: Prior to being installed

Question text

Where should the backflow preventer be installed?

Feedback

Your answer is incorrect.

The correct answer is: On the make-up waterline to the boiler upstream of the PRV

Question **38**

What is typically installed in the top of an air scoop?

Feedback

Your answer is incorrect.

The correct answer is: Automatic air vent

Question text

Where is the best location for an automatic air vent to be installed?

Feedback

Your answer is incorrect.

The correct answer is: High points

Question text

What is the operating control for the gas valve on a steam boiler?

Feedback

Your answer is incorrect.

The correct answer is: Pressuretrol

Question text

What type of mixing valve would be used to control the water temperature to a radiant infloor heating system when a non-condensing boiler is being used as the heating source?

Feedback

Your answer is incorrect.

The correct answer is: 4 way

Question text

What is the maximum floor surface temperature permitted by the CSA B214 standard for a living room in a dwelling unit (more than 3 ft. (0.9 m) from an outside wall?

Feedback

Your answer is incorrect.

The correct answer is: 88 °F (31 °C)

Question text

Which of the following devices would typically be used to ensure that the inducer fan is working on a fan-assisted hot water boiler?

Feedback

Your answer is incorrect.

The correct answer is: Pressure switch

Question text

If an atmospheric burner is experiencing flame lift-off and both the manifold pressure and orifice size are correct, what is the most likely cause?

Feedback

Your answer is incorrect.

The correct answer is: Too much primary air

Question text

If a boiler that contains an atmospheric burner is experiencing flame rollout and both the manifold pressure and orifice size are correct, what is the most likely cause?

Feedback

Your answer is incorrect.

The correct answer is: Restricted flue passages

Question text

What is the minimum distance above a roof that an S636 venting system may terminate if it is serving a Category IV hot water boiler?

Feedback

Your answer is incorrect.

8.14.3

The correct answer is: 1.5 ft (450 mm)

Question text

What type of venting may be used downstream of an automatically operated vent damper serving a residential gas-fired boiler?

Feedback

Your answer is incorrect.

Code Clause 8.26.2

The correct answer is: Type B

\

Question text

Where is the best location for a vent damper?

Select one:
a.

Feedback

Your answer is incorrect.

The correct answer is: Vertically downstream of the draft hood

Question text

What is the typical voltage required for an electric vent damper motor?

d.
24 volt

Feedback

Your answer is incorrect.

The correct answer is: 24 volt

Question **50**
Not answered
Marked out of 1.00
Flag question

Question text

What is the term used to describe when the flue gas travels the length of a firetube boiler?

Feedback

Your answer is incorrect.

The correct answer is: Pass

HOT WATER HEATER

Which of the following is not a type of appliance used to heat domestic hot water?

Select one:
a.
Tankless Water Heater

b.
Storage Tank Water Heater

c.
Reverse Return Water heater
d.
Indirect Water Heater

Feedback

Your answer is incorrect.

The correct answer is: Reverse Return Water heater

Question **2**
Not answered
Marked out of 1.00
Flag question

Question text

What does FVIR indicate when referring to hot water tanks?

Select one:
a.
Flammable Vapour Ignition Resistant
b.
Forced Variable Ignition Resistance

c.
Flammable Vapour Ignition Response

d.
Forced Variable Ignition Response

Feedback

Your answer is incorrect.

The correct answer is: Flammable Vapour Ignition Resistant

Question **3**
Not answered
Marked out of 1.00

Flag question

Question text

Where is the TCO located on a hot water tank?

Select one:
a.
Just inside the outer door or part of the pilot assembly
b.
At the top of the tank not in direct sun light

c.
Just outside the outer door or part of the pilot assembly

d.
Just outside the outer door or part of the main burner assembly

Feedback

Your answer is incorrect.

The correct answer is: Just inside the outer door or part of the pilot assembly

Question **4**
Not answered
Marked out of 1.00
Flag question

Question text

Which type of gas valve may incorporate an “ECO”?

Select one:
a.
Pilot Operated

b.
Rod and Tube
c.
Redundant

d.
Tube and Shell

Feedback

Your answer is incorrect.

The correct answer is: Rod and Tube

Question **5**
Not answered
Marked out of 1.00
Flag question

Question text

Where is a flammable vapour sensor located on a hot water tank?

Select one:
a.
Above the heat exchanger

b.
In the combustion chamber

c.
Near the combustion air intake
d.
In the plenum

Feedback

Your answer is incorrect.

The correct answer is: Near the combustion air intake

Question **6**
Not answered
Marked out of 1.00
Flag question

Question text

How do you test a flammable vapour sensor?

Select one:
a.
With an ammeter

b.
With an incline manometer

c.
With a match

d.
With an ohmmeter

Feedback

Your answer is incorrect.

The correct answer is: With an ohmmeter

Question **7**
Not answered
Marked out of 1.00
Flag question

Question text

Which devices are wired in series with an ECO ?

Select one:
a.
Thermocouple, Safety Shut-off and possibly a TCO
b.
Thermocouple, BVI and BPI
c.
Flame roll out, Thermistor and Fan Switch
d.
Flame roll out, BVI and Fan switch

Feedback

Your answer is incorrect.

The correct answer is: Thermocouple, Safety Shut-off and possibly a TCO

Question **8**
Not answered
Marked out of 1.00
Flag question

Question text

Which device is typically used to monitor inlet and outlet water temperatures on a tankless heater?

Select one:
a.
Thermostats
b.
Flame Roll Out Switch
c.
Fan Switch
d.
Thermistors

Feedback

Your answer is incorrect.

The correct answer is: Thermistors

Question **9**

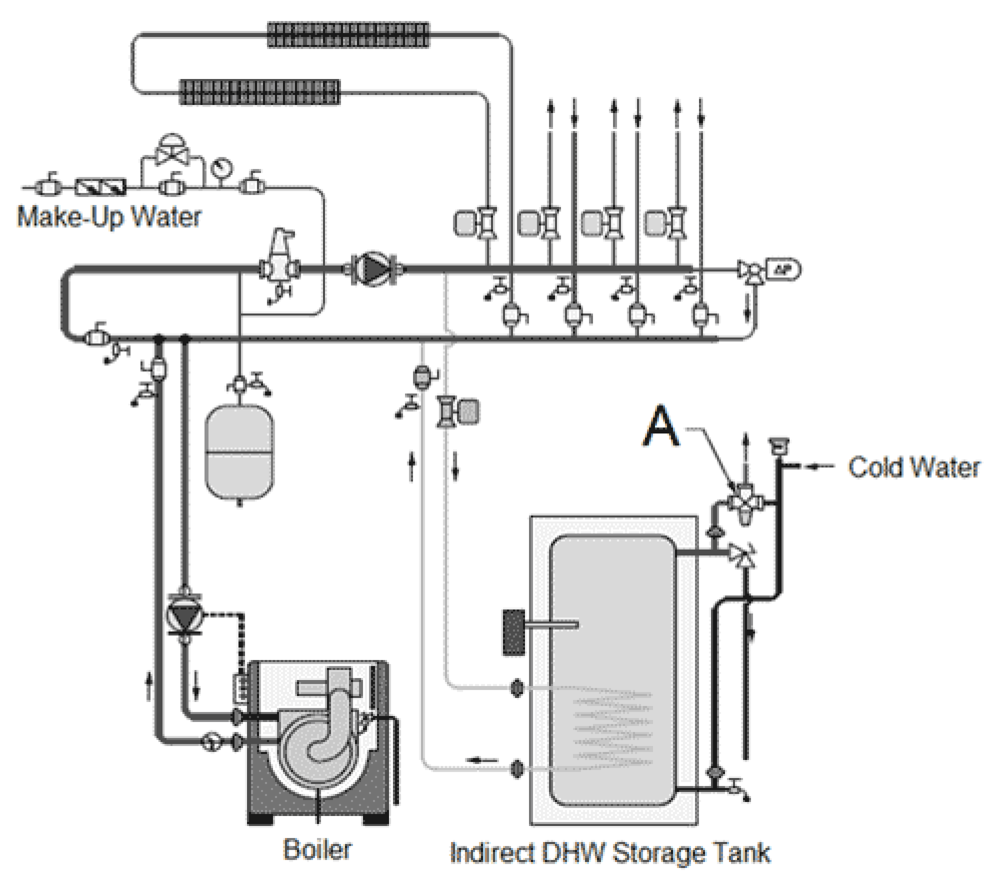
Not answered

Marked out of 1.00

Flag question

Question text

Identify Item “A” in the illustration shown below:



Select one:

a.
Flow Switch

b.
Flow Control Valve

c.
Mixing or Tempering Valve

d.
Balancing Valve

Feedback

Your answer is incorrect.

The correct answer is: Mixing or Tempering Valve

Question **10**

Not answered

Marked out of 1.00

Flag question

Question text

What is the maximum permitted temperature to be supplied to either a shower or bathtub ?

Select one:

a.

120 F

b.

100 ^{0} F

c.

140 F

d.

160 F

Feedback

Your answer is incorrect.

The correct answer is: 120 F

Question **11**

Not answered

Marked out of 1.00

Flag question

Question text

Which devices are typically used to protect against thermal expansion in a domestic hot water system and prevent the T&P relief valve from discharging?

Select one:

a.

Expansion Tank and Auxiliary Relief Valve

b.

Thermodynamic Steam Trap

c.

Flow Control Valve

d.

Auxiliary Receiver

Feedback

Your answer is incorrect.

The correct answer is: Expansion Tank and Auxiliary Relief Valve

Question **12**

Not answered

Marked out of 1.00

Flag question

Question text

At what pressure should a potable expansion tank be pre-charged?

Select one:

a.

Same as the pressure reducing valve

b.

5 Psig above the cut in pressure

c.

5 Psig above the cut out pressure

d.

30 Psig

Feedback

Your answer is incorrect.

The correct answer is: Same as the pressure reducing valve

Question **13**

Not answered

Marked out of 1.00

Flag question

Question text

What problem may be encountered if a tankless heater was set at 130 F (54 C) ?

Select one:

a.

Excessive calcification will occur on the inside of the heat exchanger.

b.

The heater may not have the capacity to reach that temperature due to the heat input, flow rate and/or inlet water temperature.

c.

The water would never get warm enough and the Low Limit Water Sensor would constantly trip.

d.

No problems will occur. This is normal operating temperature for a tankless heater

Feedback

Your answer is incorrect.

The heater may not have the capacity to reach that temperature due to the heat input, flow rate and/or inlet water temperature.

The correct answer is: The heater may not have the capacity to reach that temperature due to the heat input, flow rate and/or inlet water temperature.

Question **14**
Not answered
Marked out of 1.00
Flag question

Question text

Identify the four different configurations available for hot water tanks based upon how the combustion air is being supplied and how the appliance is vented:

Select one:
a.
Atmospheric or Natural Draft, Direct Vent, Power Vented, Powered Direct Vent

b.
Atmospheric or Negative Draft, Direct Vent, Power Vented, Powered Belt Driven Direct Vent

c.
Power or Positive Draft, Direct Vent, Power Vented, Powered Belt Driven Vent

d.
Forced Draft, Indirect Vent, Power Vented, Powered Direct Vent

Feedback

Your answer is incorrect.

Atmospheric or Natural Draft, Direct Vent, Power Vented, Powered Direct Vent

The correct answer is: Atmospheric or Natural Draft, Direct Vent, Power Vented, Powered Direct Vent

Question **15**
Not answered
Marked out of 1.00
Flag question

Question text

Describe a concentric venting system:

Select one:
a.

The exhaust reduces in size depending on the length

b.
The exhaust vent is located inside the air supply pipe

c.
The exhaust increases in size depending on the length

d.
The exhaust vent is located outside the air supply pipe

Feedback

Your answer is incorrect.

The exhaust vent is located inside the air supply pipe

The correct answer is: The exhaust vent is located inside the air supply pipe

Question **16**
Not answered
Marked out of 1.00
Flag question

Question text

What are the three styles of tankless heaters based on venting and combustion air supply ?

Select all that apply.

Select one or more:
a.
Positive Displacement

b.
Outdoor

c.
Direct Vent Indoor

d.
Non Direct Vent Indoor

Feedback

Your answer is incorrect.

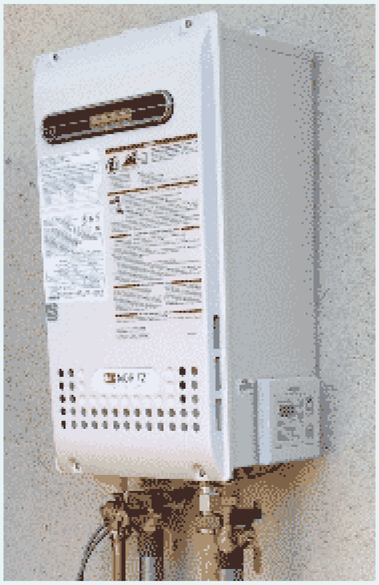
Non Direct Vent Indoor, Direct Vent Indoor, Outdoor

The correct answers are: Non Direct Vent Indoor, Direct Vent Indoor, Outdoor

Question **17**
Not answered
Marked out of 1.00
Flag question

Question text

Is the tankless water heater illustrated below designed for indoor or outdoor use?



Select one:
a.
Outdoor

b.
Indoor

Feedback

Your answer is incorrect.

Outdoor - no vents

The correct answer is: Outdoor

Question **18**
Not answered
Marked out of 1.00
Flag question

Question text

The following description is for which type appliance?

The appliance is located in a mechanical room and the air supply is taken directly from the outdoors to the appliance and then vented directly to the outdoors

Select one:
a.
Counter Flow

b.

Direct Vent

c.
Outdoor

d.
Indirect Vent

Feedback

Your answer is incorrect.

With a direct vent appliance the air supply is taken directly from the outdoors to the appliance and then vented directly to the outdoors

The correct answer is: Direct Vent

Question **19**
Not answered
Marked out of 1.00
Flag question

Question text

What is the advantage of a vent damper installed on a hot water tank ?

Select one:
a.
Slows down the products of combustion

b.
It increases standby losses

c.
It reduces standby losses
d.
Recirculates flue gases

Feedback

Your answer is incorrect.

The correct answer is: It reduces standby losses

Question **20**
Not answered
Marked out of 1.00
Flag question

Question text

What is the minimum acceptable voltage for a thermocouple when conducting an open circuit test?

Select one:

a.
20 millivolts
b.
10 millivolts

c.
24 volts

d.
12 volts

Feedback

Your answer is incorrect.

The correct answer is: 20 millivolts

Question **21**
Not answered
Marked out of 1.00
Flag question

Question text

What is the anticipated current flow through a flame rod?

Select one:
a.
2 – 5 microvolts

b.
1 – 2 microamps

c.
1 – 2 microvolts

d.
2 – 5 microamps

Feedback

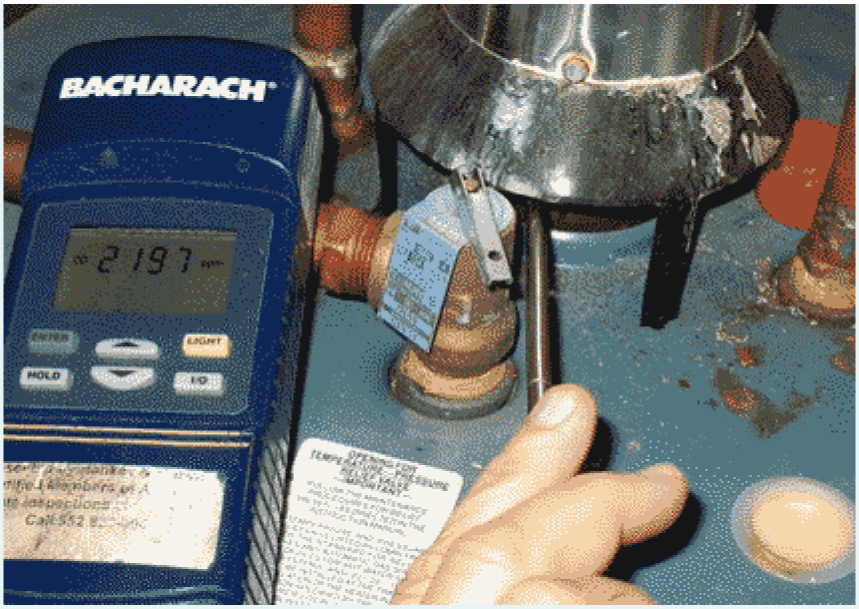
Your answer is incorrect.

The correct answer is: 2 – 5 microamps

Question **22**
Not answered
Marked out of 1.00
Flag question

Question text

Is the carbon monoxide reading on the flue gas analyzer illustrated below acceptable for this installation?



Select one:
a.
Yes

b.
No

Feedback

Your answer is incorrect.

No, the maximum permitted CO level is 100 ppm

The correct answer is: No

Question **23**
Not answered
Marked out of 1.00
Flag question

Question text

What are the two venting configurations encountered for “Direct Vent” tankless water heaters?

Select one:
a.
Eccentric (or Coaxial) and individual pipe

b.
Recirculation and two individual pipes

c.
Concentric (or Coaxial) and two individual pipes

d.
Atmospheric and two individual pipes

Feedback

Your answer is incorrect.

The correct answer is: Concentric (or Coaxial) and two individual pipes

Question **24**
Not answered
Marked out of 1.00
Flag question

Question text

Which type of anode should be used if the water contains “Divibrio Sulfurican” bacteria?

Select one:
a.
Stainless steel

b.
Copper

c.
Aluminum
d.
Carbon Steel

Feedback

Your answer is incorrect.

The correct answer is: Aluminum

Question **25**
Not answered
Marked out of 1.00
Flag question

Question text

What can be used to flush a tankless water heater?

Select one:
a.
Potassium Permanganate

b.
Bleach and Water

c.
Saline Solution

d.
Vinegar and Water

Feedback

Your answer is incorrect.

Disconnect the power supply and shut-off the gas supply. Isolate the heater and circulate 5 gallons (19 l) of vinegar or citric acid through the appliance for 45 minutes and then flush with water for 5 minutes.

The correct answer is: Vinegar and Water

Question **26**
Not answered
Marked out of 1.00
Flag question

Question text

What appliance is typically used to heat the domestic hot water for an indirect storage tank?

Select one:
a.
Boiler

b.
Fireplace

c.
Direct fired hot water tank

d.
Furance

Feedback

Your answer is incorrect.

The correct answer is: Boiler

Question **27**
Not answered
Marked out of 1.00
Flag question

Question text

What is the temperature range for a TCO that is integral with a thermocouple?

Select one:
a.
120 °F - 160 °F

b.

160 °F - 200 °F

c.
100 °F - 140 °F

d.
180 °F - 220 °F

Feedback

Your answer is incorrect.

The correct answer is: 160 °F - 200 °F

Question **28**
Not answered
Marked out of 1.00
Flag question

Question text

Which multimeter setting would be used to test a thermistor?

Select one:
a.
Ohms

b.
DC Micro-Amps

c.
DC Millivoltage

d.
AC Voltage

Feedback

Your answer is incorrect.

The correct answer is: Ohms

Question **29**
Not answered
Marked out of 1.00
Flag question

Question text

What is the minimum acceptable voltage for a thermocouple when conducting a closed circuit test ?

Select one:
a.
20 mv

b.
10 mv

c.
30 mv

d.
5 mv

Feedback

Your answer is incorrect.

The correct answer is: 10 mv

Question **30**
Not answered
Marked out of 1.00
Flag question

Question text

Which device is used to prove ignition of the main burner in a tankless water heater?

Select one:
a.
Thermistor

b.
Thermocouple

c.
HIgh limit

d.
Flame rod

Feedback

Your answer is incorrect.

The correct answer is: Flame rod

Question **31**
Not answered
Marked out of 1.00
Flag question

Question text

If an auxiliary relief valve is used rather than an expansion tank, what should be the setpoint?

Select one:
a.

10 Psig (70 kPa) above the tank relief valve setting
b.
60 Psig (420 kPa)
c.
80 Psig (550 kPa)
d.
10 Psig (70 kPa) below the tank relief valve setting

Feedback

Your answer is incorrect.

The correct answer is: 10 Psig (70 kPa) below the tank relief valve setting

Question **32**
Not answered
Marked out of 1.00
Flag question

Question text

Which of the following devices would be required on a hot water tank but not on a tankless heater?

Select one:
a.
Flow switch
b.
Temperature relief valve
c.
Pressure reducing valve
d.
Pressure relief valve

Feedback

Your answer is incorrect.

The correct answer is: Temperature relief valve

Question **33**
Not answered
Marked out of 1.00
Flag question

Question text

What is the optimum water pressure range for a tankless water heater?

Select one:
a.
80 – 130 Psi (550 – 900 kPa)

b.
100 – 150 Psi (700 – 1,035 kPa)

c.
50 – 100 Psi (345 – 700 kPa)
d.
30 – 80 Psi (200 – 500 kPa)

Feedback

Your answer is incorrect.

The correct answer is: 30 – 80 Psi (200 – 500 kPa)

Question **34**
Not answered
Marked out of 1.00
Flag question

Question text

What is the minimum height that ULC S636 venting may terminate above a roof ?

Select one:
a.
1.5 Feet (450 mm)
b.
4.0 Feet (1200 mm)

c.
3.0 Feet (900 mm)

d.
2.0 Feet (600 mm)

Feedback

Your answer is incorrect.

Code Clause 8.14.3

The correct answer is: 1.5 Feet (450 mm)

Question **35**
Not answered
Marked out of 1.00
Flag question

Question text

If a tankless water heater is being vented through a sidewall, what is the minimum height that it may terminate above a sidewalk or a paved driveway that is located on public property?

Select one:

a.
15 Feet (4.5 m)

b.
3 Feet (0.9 m)

c.
7 Feet (2.1 m)

d.
5 Feet (1.5 m)

Feedback

Your answer is incorrect.

Code Clause 8.14.8

The correct answer is: 7 Feet (2.1 m)

Question **36**
Not answered
Marked out of 1.00
Flag question

Question text

How often should a T&P relief valve be removed and visually inspected ?

Select one:
a.
Every 5 years

b.
Every 7 years

c.
Annually

d.
Every 3 years

Feedback

Your answer is incorrect.

The correct answer is: Every 3 years

Question **37**
Not answered
Marked out of 1.00
Flag question

Question text

If the pressure reading on a manometer is 0.85 inches water column when testing a pressure switch with an activation point of 1.07 inches water column which component(s) would most likely require service?

Select one:
a.
The vent damper and/or end switch
b.
The thermostat and/or high limit
c.
The pressure switch and/or condensate trap
d.
The inducer motor and/or sensing tube

Feedback

Your answer is incorrect.

The correct answer is: The inducer motor and/or sensing tube

Question **38**
Not answered
Marked out of 1.00
Flag question

Question text

What type of venting should typically be used with a Category I Natural Draft hot water tank?

Select one:
a.
PVC

b.
CPVC

c.
Type B Vent

d.
Type A Vent

Feedback

Your answer is incorrect.

The correct answer is: Type B Vent

Question **39**
Not answered
Marked out of 1.00

Flag question

Question text

What is the color of S636 PVC venting?

Select one:

a.
Grey

b.
Blue

c.
Black

d.
White

Feedback

Your answer is incorrect.

The correct answer is: White

Question **40**

Not answered

Marked out of 1.00

Flag question

Question text

What is the typical range for the spark gap serving a piezoelectric igniter ?

Select one:

a.
1/2 - 5/8 inch (12.7 - 15.9 mm)

b.
7/64 - 1/4 inch (2.8 - 6.4 mm)

c.
3/8 - 1/2 inch (9.5 - 12.7 mm)

d.
1/4 - 3/8 inch (6.4 - 9.5 mm)

Feedback

Your answer is incorrect.

The correct answer is: 7/64 - 1/4 inch (2.8 - 6.4 mm)

Question **41**

Not answered

Marked out of 1.00

Flag question

Question text

What should be the next step in the sequence of operation for a tankless water heater once the ventor motor is powered ?

Select one:
a.
A flame signal is received by the control module
b.
The pressure switch contacts close
c.
The igniter is energized
d.
The gas valve is energized

Feedback

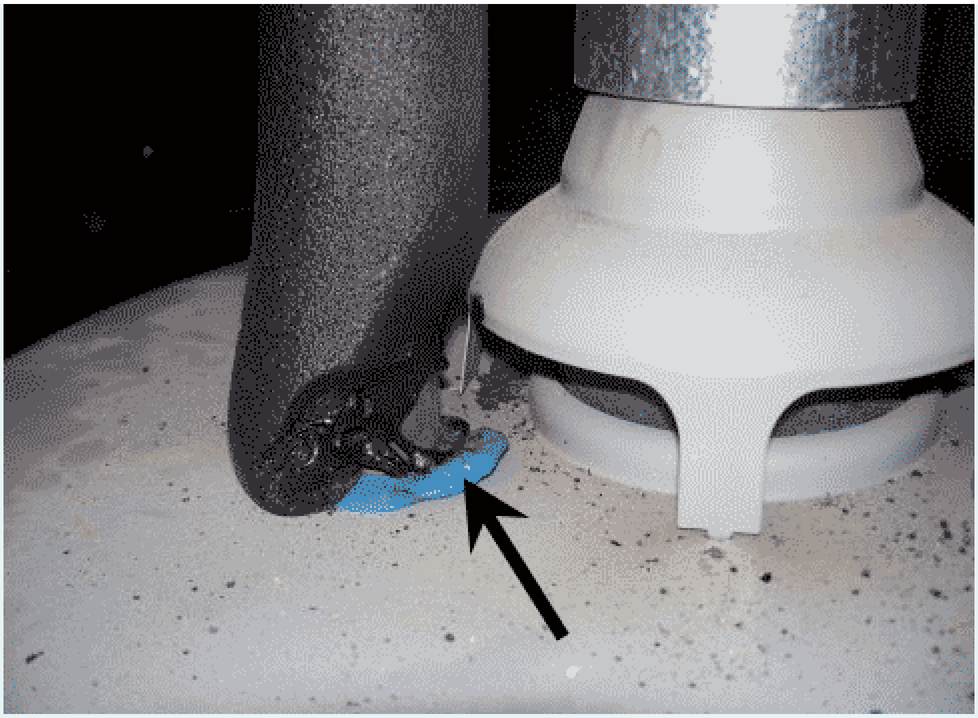
Your answer is incorrect.

The correct answer is: The pressure switch contacts close

Question **42**
Not answered
Marked out of 1.00
Flag question

Question text

If the paint surface is discoloured, or the plastic grommets installed around the hot and cold water piping on a hot water tank have melted as in the illustration below, what could be the possible cause?



Select one:

a.
Flue gas spillage

b.
Faulty high limit

c.
Plugged flame arrestor

d.
Excessive water temperature

Feedback

Your answer is incorrect.

The correct answer is: Flue gas spillage

Question **43**

Not answered
Marked out of 1.00
Flag question

Question text

If a tankless water heater has a low supply water pressure what could be the problem ?

Select one:

a.
Waterlogged expansion tank

b.
Plugged sensor tube on the pressure switch
c.
Plugged inlet screen or filter
d.
Incorrect dip switch setting on the control board

Feedback

Your answer is incorrect.

The correct answer is: Plugged inlet screen or filter

Question **44**
Not answered
Marked out of 1.00
Flag question

Question text

At what diameter should an anode rod in a hot water tank be replaced ?

Select one:
a.
3/8 inch (9.5 mm) or less
b.
1/4 inch (6.4 mm) or less

c.
1/2 inch (12.7 mm) or less

d.
5/8 inch (15.9 mm) or less

Feedback

Your answer is incorrect.

The correct answer is: 3/8 inch (9.5 mm) or less

Question **45**
Not answered
Marked out of 1.00
Flag question

Question text

If a tankless water heater has an “Overheat” or “Lime” error code what is most likely the cause ?

Select one:
a.
High gas manifold pressure

b.
Plugged combustion air inlet opening
c.
Incorrect thermostat setting
d.
Scale buildup in the heat exchanger

Feedback

Your answer is incorrect.

The correct answer is: Scale buildup in the heat exchanger

Question **46**
Incorrect
Mark 0.00 out of 1.00
Flag question

Question text

If the TCO has tripped on a hot water tank what should be checked ?

Select one:
a.
The thermostat and ECO setpoints
b.
The gas inlet and manifold pressure
c.
The air intake and flame arrestor
d.
The temperature and pressure relief valve

Feedback

Your answer is incorrect.

The correct answer is: The air intake and flame arrestor

Question **47**
Not answered
Marked out of 1.00
Flag question

Question text

If the vacuum relief valve installed in conjunction with a hot water tank was stuck in the closed position what could be the result ?

Select one:
a.
The incoming cold water could be drawn from the hot supply, leaving hot water at the bottom of the tank

b.
The tank could rupture if exposed to excessive pressure
c.
The water would be too hot
d.
The tank could collapse if exposed to a backsiphonage condition

Feedback

Your answer is incorrect.

The correct answer is: The tank could collapse if exposed to a backsiphonage condition

Question **48**
Not answered
Marked out of 1.00
Flag question

Question text

If a tankless water heater installed at an elevation of 5,000 Ft. (1,524 m) is experiencing above normal CO levels during a flue gas analysis, what is the most likely cause ?

Select one:
a.
Corroded or damaged flame rod
b.
Incorrect orifice size or dip switch setting
c.
Faulty pressure switch
d.
Insufficient water flow rate

Feedback

Your answer is incorrect.

The correct answer is: Incorrect orifice size or dip switch setting

Question **49**
Not answered
Marked out of 1.00
Flag question

Question text

If the burner in a tankless water heater fires but shuts off almost immediately, which circuit should be checked first ?

Select one:
a.
The pressure switch circuit

b.
The blower motor circuit

c.
The flame rod circuit
d.
The thermostat circuit

Feedback

Your answer is incorrect.

The correct answer is: The flame rod circuit

Question **50**
Not answered
Marked out of 1.00
Flag question

Question text

If a tankless water heater is experiencing above normal flue gas temperatures what is the most likely cause?

Select one:
a.
Plugged or dirty heat exchanger
b.
Waterlogged expansion tank
c.
Undersized gas supply piping
d.
Insufficient gas manifold pressure

Feedback

Your answer is incorrect.

The correct answer is: Plugged or dirty heat exchanger